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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	09/711,324
Filing Date	November 13, 2000
First Named Inventor	Ko et al.
Group Art Unit	1765
Examiner Name	K. Chen
Attorney Docket Number	2269-3526.4US (97-1136.05/US)

ENCLOSURES *(check all that apply)*

- ☒ Postcard receipt acknowledgment (attached to the front of this transmittal)
- ☒ Duplicate copy of this transmittal sheet in the event that additional filing fees are required under 37 C.F.R. § 1.16
- ☐ Preliminary Amendment
- ☐ Response to Restriction Requirement/Election of Species Requirement dated
- ☐ Amendment in response to office action dated
- ☐ Amendment under 37 C.F.R. § 1.116 in response to final office action dated
- ☐ Additional claims fee - Check No. in the amount of $
- ☐ Letter to Chief Draftsman and copy of FIGS. with changes made in red
- ☐ Transmittal of Formal Drawings
- ☐ Formal Drawings (sheets)
- ☐ Information Disclosure Statement, PTO/SB/08A (08-00); ☐ copy of cited references
- ☐ Supplemental Information Disclosure Statement; PTO/SB/08A (08-00); copy of cited references and Check No. in the amount of $180.00
- ☐ Associate Power of Attorney
- ☐ Petition for Extension of Time and Check No. in the amount of $
- ☐ Petition
- ☐ Fee Transmittal Form
- ☐ Certified Copy of Priority Document(s)
- ☐ Assignment Papers *(for an Application)*
- ☐ Terminal Disclaimer
- ☐ Terminal Disclaimer
- ☐ Terminal Disclaimer
- ☒ Other Enclosure(s) *(please identify below)*:

  Appeal Brief (IN TRIPLICATE) and Check No. in the amount of $330.00

Remarks

The Commissioner is authorized to charge any additional fees required but not submitted with any document or request requiring fee payment under 37 C.F.R. §§ 1.16 and 1.17 to Deposit Account 20-1469 during pendency of this application.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm *or* Individual name	Brick G. Power — Registration No. 38,581
Signature	
Date	July 6, 2004

CERTIFICATE OF MAILING

Express Mail Label Number: EV 340843459US

Date of Deposit: July 6, 2004

Person Making Deposit: Christopher Haughton

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Ko et al.

Serial No.: 09/711,324

Filed: November 13, 2000

For: ETCHANT WITH SELECTIVITY FOR DOPED SILICON DIOXIDE OVER UNDOPED SILICON DIOXIDE AND SILICON NITRIDE, PROCESSES WHICH EMPLOY THE ETCHANT, AND STRUCTURES FORMED THEREBY

Confirmation No.: 7008

Examiner: K. Chen

Group Art Unit: 1765

Attorney Docket No.: 2269-3526.4US

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APPEAL BRIEF

Mail Stop Appeal Brief—Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Attn: Board of Patent Appeals and Interferences

Sirs:

This brief is submitted in triplicate and in the format of 37 C.F.R. § 1.192(c). A check in the amount of $330.00 for the fee under 37 C.F.R § 1.17(c) for filing a brief in support of an appeal is enclosed.

As July 4, 2004, fell on a Sunday, and Monday, July 5, 2004, is a federal holiday, this Appeal Brief, which is being filed on Tuesday, July 6, 2004, should be deemed to have been submitted within two months of the mailing date of the Notice of Appeal.

(1) REAL PARTY IN INTEREST

The real party in interest in the present pending appeal is Micron Technology, Inc., the assignee of the above-refernced application as recorded with the United States Patent and Trademark Office on June 22, 1998, Reel 9273, Frame 0990.

(2) RELATED APPEALS AND INTERFERENCES

Applicants are not aware of any related applications that are on appeal or subject to other proceedings before the Board of Patent Appeals and Interferences that would influence or affect the Board's decision in the above-referenced appeal.

(3) STATUS OF THE CLAIMS

Claims 1, 2, 4, 5, and 7-46 are pending and under consideration in the above-referenced application.

Each of claims 1, 2, 4, 5, and 7-46 stands rejected.

The rejections of claims 1, 2, 4, 5, and 7-46 are being appealed.

(4) STATUS OF AMENDMENTS

The above-referenced application, U.S. Patent application serial no. 09/711,324 (hereinafter "the '324 Application"), was filed as a divisional of U.S. Patent application serial no. 09/625,144 on July 25, 2000. The '324 Application was originally filed with 38 claims.

A first Office Action on the merits was mailed by the Office on March 21, 2001. Each of claims 1-46 were rejected in the first Office Action.

On May 30, 2001, an Amendment was submitted in response to the first Office Action. That Amendment received a filing date of June 4, 2001. In that Amendment, claims 19 and 38 were amended, and reasons presented in support of the allowability of claims 1-38.

A Final Office Action was mailed by the Office on February July 3, 2001. Claims 1-38 were again rejected.

On September 10, 2001, an Amendment Under 37 C.F.R. § 1.116 was filed in response to the Final Office Action. Claim 38 was again amended, this time to correct a formal error. In addition, explanations as to the patentability of claims 1-38 were presented.

An Advisory Action followed on September 21, 2001. The Office continued to dismiss Appellants' explanations, and maintained its rejections of claims 1-38.

Thus, on September 28, 2001, a Notice of Appeal was filed, and was followed by an Appeal Brief dated November 26, 2001. An Examiner's Answer was sent on December 26, 2001. In response, a Reply Brief was submitted on February 19, 2002. On December 31, 2002, the Board mailed an "Order Remanding to Examiner" in view of a Supplemental Information Disclosure Statement that had been filed on Appellants' behalf.

Following the remand, the appeal was apparently reinstated, as a "Decision on Appeal" was mailed on April 21, 2003. In the Decision, the Board affirmed the Office's rejections of claims 1-38.

Noting a difference between the dry etchants that are described in the '324 Application and the prior art etchant mixtures that had been relied upon by the Office in its rejections of claims 1-38, Appellants' representatives filed a Request for Continued Examination (RCE) and accompanying Amendment on July 21, 2003, to continue prosecution of the '324 Application. In the amendment, revisions to claims 1, 4, 5, 7-10, 12, 14, 15, 17-20, and 38 were presented, claims 3 and 6 were canceled without prejudice or disclaimer, and new claims 39-46 were added.

The RCE and accompanying Amendment were followed by another nonfinal Office Action on the merits of claims 1-46, which was mailed by the Office on September 22, 2003. In that Office Action, it was asserted that all of the language that had been amended into independent claims 1 and 20 could be disregarded. In the Office's estimation, this allowed for maintenance of the previously established grounds of rejection.

An Amendment was mailed in response to the Office Action of September 22, 2003, on December 29, 2003, and received a filing date of January 2, 2004. Formal amendments to claims 1, 4, 5, 7-20, 23, 25-41, and 43-45 (replacement of "said" with "the") were presented in the Amendment of September 22, 2003, along with support for the previously submitted revisions to claims 1-38. No further claim amendments have been submitted in the '324 Application.

Thereafter, on February 17, 2004, the Office issued another Final Office Action.

A response to the Final Office Action followed on April 16, 2004, again setting forth support for the revised claim language, as well as establishing that one of ordinary skill in the art would consider such language to be definite.

As indicated in the Advisory Action dated April 27, 2004, the Office chose to reject the explanations that were provided in the response dated April 16, 2004.

Accordingly, another Notice of Appeal was filed on May 4, 2004, and is followed by this Appeal Brief.

(5) SUMMARY OF THE INVENTION

The invention that is disclosed in and recited in the claims of the '324 Application relates to dry etchants etching doped silicon dioxide with selectivity over silicon nitride and undoped silicon dioxide. Page 8, lines 24 and 25.

Doped silicon dioxide typically includes a dopant such as boron or phosphorus, whereas undoped silicon dioxide is substantially free of dopants and other impurities. Examples of doped silicon dioxide include, but are not limited to, borosilicate glass (BSG), phosphosilicate glass (PSG) and borophosphosilicate glass (BPSG). Page 8, lines 28 and 29.

The selective dry etchant of the '324 Application includes an ethane component having the general formula $C_2H_xF_y$, where x is an integer from two to five, inclusive, y is an integer from one to four, inclusive, and x plus y equals 6. Page 9, lines 3-7. As the $C_2H_xF_y$ component of a doped silicon dioxide etchant is RF activated, the hyrdrogen ions and activated hydrogen species react with the fluorine-containing ions and activated fluorine-containing species (*e.g.*, F* and CF*), removing the activated fluorine-containing species from the surface of the wafer prior to

the occurrence of any substantial amount of etching of an etch stop layer of either undoped silicon dioxide or silicon nitride. Page 9, lines 11-16.

Where $C_2H_xF_y$ is utilized as a primary component of a dry etchant, which may include, as secondary components, one or more other flurocarbons or other halogenated carbon materials. These secondary components, which have been used as primary etchants in conventional doped silicon dioxide dry etch techniques, may be added because $C_2H_xF_y$ etches doped silicon dioxide at relatively slow rate compared with the etch rates of conventional silicon dioxide etchants. Page 9, lines 23-27.

Alternatively, $C_2H_xF_y$ may be employed as an additive to, or secondary component of, one or more fluorocarbon primary components of a dry etchant which etches silicon dioxide at a higher rate than they etch silicon nitride. When $C_2H_xF_y$ is used as an additive, $C_2H_xF_y$ imparts the etchant mixture with selectivity for doped silicon dioxide over undoped silicon dioxide, while permitting the doped silicon dioxide etch to proceed at a comparable rate relative to many conventional doped silicon dioxide dry etch techniques. Page 10, lines 12-16. In addition, the amounts of other etchants may be varied in order to more specifically tailor the selectivity of an etchant combination for doped silicon dioxide over undoped silicon dioxide, and for doped silicon dioxide over silicon nitride, as well as to control the rate at which doped silicon dioxide etched. Page 10, lines 19-28.

In the claims of the '324 Application, these dry etchants are characterized as consisting essentially of fluorocarbons including $C_2H_xF_y$.

Dry etchants according to the invention disclosed in the '324 Application may be effectively employed to anisotropically etch a doped silicon dioxide layer down to an underlying

etch stop comprising either undoped silicon dioxide or silicon nitride. A mask layer is patterned over the doped silicon dioxide layer. Page 12, lines 13 and 14. Such a dry etchant is introduced to attack the open areas not covered by the photomask. Page 13, lines 10-12. The anisotropic dry etching processes available for use with the invention disclosed in the '324 Application include, without limitation, high density plasma etching, reactive ion etching, magnetic ion etching, magnetically enhanced reactive ion etching, plasma etching, point plasma etching, plasma enhanced reactive ion etching, and electron cyclotron resonance. Page 13, lines 12-18.

The dry etchant and selective, anisotropic etching process may be used to form at least one sidewall from a layer of passivation material, such as doped silicon dioxide, that is oriented substantially vertical to a plane of a substrate over which the layer of passivation material is located and that at least partially terminates at an undoped silicon dioxide structure. Page 12, line 26, to page 13, line 5; FIG. 4. An example of such a structure may comprise a contact opening to an active device region located adjacent to at least one transistor gate. *Id.* The side walls of the contact opening may be oriented substantially perpendicular to a plane of the underlying semiconductor substrate and include portions that terminate at an undoped silicon dioxide cap of the at least one transistor gate structure. *Id.*

(6) ISSUES

(A) Whether, under 35 U.S.C. § 112, first paragraph, claims 1, 2, 4, 5, and 7-46 recite subject matter which is described in the specification of the '324 Application in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the '324 Application was filed, had possession of the claimed invention;

(B) Whether the recitation of "consisting essentially of" in claims 1, 2, 4, 5, and 7-46 would be considered to comply with the definiteness requirement of 35 U.S.C. § 112, second paragraph; and

(C) Whether claims 1, 2, 4, 5, and 7-46 are directed to subject matter that, under 35 U.S.C. § 103(a) is patentable over the subject matter taught in U.S. Patent 5,814,563 to Ding et al. (hereinafter "Ding"), in view of teachings from U.S. Patent 5,626,716 to Bosch et al. (hereinafter "Bosch").

(7) GROUPING OF CLAIMS

Group 1 – 35 U.S.C. § 112, First Paragraph, Rejection of Claims 1, 2, 4, 5, and 7-46:

With respect to the 35 U.S.C. § 112, first paragraph, rejection of the claims, claims 1, 2, 4, 5, and 7-46 should be grouped together, with claim 20 being the most generic and claims 1, 2, 4, 5, 7-19, and 21-46 standing and falling with claim 20.

Group 2 – 35 U.S.C. § 112, First Paragraph, Rejection of Claim 18:

Claim 18 has also been individually rejected under 35 U.S.C. § 112, first paragraph. For purposes of considering the propriety of this rejection, claim 18 should be grouped alone.

Group 3 – 35 U.S.C. § 112, Second Paragraph, Rejection of Claims 1, 2, 4, 5, and 7-46:

For the 35 U.S.C. § 112, second paragraph, rejection of claims 1, 2, 4, 5, and 7-46, each of these claims should be grouped together. Claim 20 is the most generic claim of this group. Claims 1, 2, 4, 5, 7-19, and 21-46 stand with claim 20. As the objected-to, "comprising"

language does not appear in any of claims 1, 2, 4, 5, 7, 10-12, 14, 17-23, 29, 31, 33, or 36-38, it none of these claims falls with claim 20.

Group 4 – 35 U.S.C. § 103(a) Rejection of Claims 1, 2, 4, 5, and 7-46:

In considering the propriety of the 35 U.S.C. § 103(a) rejection of claims 1, 2, 4, 5, and 7-46, each of these claims should be grouped together. Each of claims 1, 2, 4, 5, 7-19, and 21-42 stands and falls with claim 20.

(8) ARGUMENT

(A) Rejections Under 35 U.S.C. § 112, First Paragraph

Claims 1, 2, 4, 5, and 7-46 stand rejected under 35 U.S.C. § 112, first paragraph, for reciting subject matter which has allegedly not been described in the specification of the above-referenced application in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

Specifically, it has been asserted that the recitation "consisting essentially of" in independent claims 1 and 20 is a negative limitation and, therefore, constitutes new matter. This is because the originally-filed specification of the above-referenced application purportedly does not limit a dry etchant to an etchant which merely includes a first component and a second component having the features that are recited in independent claim 1 or the at least one fluorocarbon recited in independent claim 20.

(1) Legal Authority

The first paragraph of 35 U.S.C. § 112, provides:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Negative limitations are identified in M.P.E.P. § 2173.05(i) as limitations that "define the invention in terms of what it [is] not . . ." The M.P.E.P. goes so far as to provide examples of negative limitations, including "other than," "being free from," and "incapable of." M.P.E.P. § 2173.05(i). The M.P.E.P. does not, in section 2173.01(i) or elsewhere, define the transitional phrase "consisting essentially of" as a negative limitation or an exclusionary phrase.

M.P.E.P. § 2111.03 indicates that "'consisting essentially of' . . . occupies a middle ground between the closed claims that are written in a 'consisting of' format and fully open claims that are drafted in a 'comprising' format." While the M.P.E.P. expressly provides that the transitional phrase "consisting of" is exclusionary, it merely indicates that the transitional phrase "'consisting essentially of' limits the scope of a claim to the specified materials or steps 'and those that do not materially affect the basic and novel characteristic(s)' of the claimed invention." M.P.E.P. § 2111.03 (citation omitted). It is understood that M.P.E.P. § 2111.03 places the "burden of showing that the introduction of additional steps or components would materially change the characteristics of [the claimed] invention" on the appellants if they "contend[] that additional steps or materials in the prior art are excluded by the recitation of 'consisting essentially of.'"

Nowhere does the M.P.E.P. state that "consisting essentially of" can only be used in a claim where that exact phrase, or some negative limitation or exclusionary phrase, appears in the specification.

(2) Analysis

Claims 1, 2, 4, 5, and 7-46

It is respectfully submitted that independent claims 1 and 20 are in condition for allowance under 35 U.S.C. § 112, first paragraph.

The specification of the '324 Application describes dry etchants that include all of the essential elements that are recited in independent claims 1 and 20. The specification of the above-referenced application also lacks any mention of an etchant which includes a component other than those recited in claims 1 and 20 that would "'materially alter the novel and basic characteristics' of the claimed invention." In fact, in describing examples of inventive etchants, the specification does not mention that the disclosed dry etchant includes any essential elements other than a $C_2H_xF_y$ component and, optionally, one or more fluorocarbons, such as CF_4 or CHF_3.

Independent claim 20 recites a dry etchant consisting essentially of at least one fluorocarbon that includes a component comprising $C_2H_xF_y$. Again, the at least one fluorocarbon could also include a CF_4, CHF_3, another fluorocarbon, or any combination of flurocarbons.

Both the Examiner and the Board have already made abundantly clear their positions that substitution of one fluorocarbon for another would be readily within the skill of one of ordinary skill in the art, as they all have similar properties, are "equivalent," and have "similar etching characteristics." *See e.g.,* Final Office Action, page 4. This reasoning is contradicted by the

Examiner's new position that various combinations of flurocarbons, including $C_2H_xF_y$ and CHF_3 could "alter the various characteristics of [an] etchant." Final Office Action, page 6.

As fluorocarbons are a specific class of components with characteristics that, according to the Office, are similar to one another, it is respectfully submitted that any combination of flurocarbons would not materially alter the characteristics of the claimed etchant. Further, it is respectfully submitted that the inclusion of "consisting essentially of" in independent claim 20 merely serves to limit the additional elements of a dry etchant to those which do not materially alter the characteristics of the dry etchant.

With this in mind, the only mention of anything other than a $C_2H_xF_y$ component and one or more fluorocarbons, such as CF_4 or CHF_3, is made at page 10, lines 14-16, of the specification of the above-referenced application, where use of a carrier gas with the etchant is mentioned. The specification of the above-referenced application, at page 12, lines 10-12, provides that the etchant may be introduced into an etch chamber with or without a carrier gas, as the use of a carrier gas is not believed to materially alter the selectivity of the etchant.

Turning now to the additional components of dry etchants in the prior art, it is respectfully submitted that both Bosch and Ding disclose dry etchants that include non-fluorocarbon components that materially change the characteristics of the fluorocarbon components of these etchants.

In this regard, Bosch expressly indicates that neon provides the etchant disclosed therein with a "special advantage." Col. 2, lines 45-48; col. 6, lines 13-28. In particular, Bosch teaches that neon provides a "high degree of selectivity . . .," "a better profile for the sidewall of the etched opening . . .," and "a sharper edge to the top of the opening . . ." Col. 6, lines 17-22.

Therefore, according to Bosch, a dry etchant that includes neon has materially different characteristics than a similar fluorocarbon-containing dry etchant that lacks neon.

In addition to a fluorocarbon component, the dry etchant of Ding includes an NH_3-generating gas and carbon-oxygen gas. Col. 2, line 62, to col. 3, line 8. The NH_3-generating gas materially changes the characteristics of the fluorocarbon component of Ding's dry etchant by "provid[ing] increased etch rates and higher etching selectivity." Col. 6, lines 16-19; *see, generally,* col. 6, line 14, to col. 8, line 64. Ding also explains that the inclusion of a carbon-oxygen gas in the fluorocarbon-containing dry etchant thereof "substantially improves the processing window of the etching process, allowing the process to be operated in a wider range of process conditions." Col. 9, lines 25-28; *see, generally,* col. 8, line 65, to col. 10, line 38. Therefore, according to Ding, the additional components of the dry etchant described in Ding materially change the characteristics of the dry etchant relative to a dry etchant that consists essentially of at least one fluorocarbon.

It is, therefore, respectfully submitted that independent claim 20 complies with the requirements of the first paragraph of 35 U.S.C. § 112, as does independent claim 1. The sole basis for rejecting claims 2, 4, 5, 7-19, and 21-46 under 35 U.S.C. § 112, first paragraph, is their dependencies from claims 1 and 20. Accordingly, it is also respectfully submitted that each of claims 2, 4, 5, 7-19, and 21-46 is also in condition for allowance under 35 U.S.C. § 112, first paragraph.

Claim 18

Claim 18 has been rejected because the specification of the above-referenced application purportedly fails to provide an adequate written description for the recitation of an etchant that includes a first component and a primary etchant "etches doped silicon dioxide at a same rate as" doped silicon dioxide is etched by another "etchant that includes [the] primary etchant but not the first component." Support for this recitation is provided, for example, at page 9, lines 19-22, of the specification of the above-referenced application, which describes an etchant that "permit[s] [a] doped silicon dioxide etch to proceed at a substantially normal rate."

Therefore, it is respectfully submitted that, under 35 U.S.C. § 112, first paragraph, claim 18 is in condition for allowance.

In view of the foregoing, it is respectfully requested that the 35 U.S.C. § 112, first paragraph, rejections of claims 1, 2, 4, 5, and 7-46 be reversed.

(B) Rejections Under 35 U.S.C. § 112, Second Paragraph

Claims 1, 2, 4, 5, and 7-46 stand rejected under 35 U.S.C. § 112, second paragraph, for purportedly being indefinite. More specifically, these claims have been rejected because independent claims 1 and 20 recite "consisting essentially of," an allegedly close-ended term, but are modified by open-ended claims.

(1) Legal Authority

The second paragraph of 35 U.S.C. § 112 provides, "[t]he specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention."

(2) Analysis

The basis for this rejection is unclear. Neither the Patent Office rules (37 C.F.R.) nor the M.P.E.P. prohibits structuring claims in this manner; apparently because dependent claims that include the transitional term "comprising" further limit an element of the close-ended "consisting essentially of" group.

It is respectfully submitted that, because the term "comprising" in a dependent claim merely serves to further limit an element of an independent claim, it cannot negate the effect of the recitation of "consisting essentially of" in the independent claims. The independent claims recite dry etchants that consist essentially of one or more particular elements. Of the elements recited, *at least one* fluorocarbon is included. By reciting what the *at least one* fluorocarbon "comprises," the dependent claims merely introduce additional limitations; the use of "comprising" in the dependent claims does not make it possible for the *at least one* fluorocarbon of the independent claims to include anything (besides nonessential components) other than one or more fluorocarbons.

Therefore, it is respectfully submitted that claims 1, 2, 4, 5, and 7-46 comply with the requirements of the second paragraph of 35 U.S.C. § 112. Accordingly, it is respectfully

submitted that each of these claims is in condition for allowance and requested that the 35 U.S.C. § 112, second paragraph, rejections of these claims be reversed.

(C) Rejections Under 35 U.S.C. § 103(a)

Claims 1, 2, 4, 5, and 7-46 stand rejected under 35 U.S.C. § 103(a) for reciting subject matter which is assertedly unpatentable over the subject matter taught in U.S. Patent 5,814,563 to Ding et al. (hereinafter "Ding"), in view of teachings from U.S. Patent 5,626,716 to Bosch et al. (hereinafter "Bosch").

(1) Legal Authority

The standard for establishing and maintaining a rejection under 35 U.S.C. § 103(a) is set forth in M.P.E.P. § 706.02(j), which provides:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

(2) References Relied Upon

Ding

Ding teaches, among other things, a dry etchant that includes a fluorocarbon gas, an ammonia-generating (NH_3-generating) gas, and a carbon-oxygen gas is used to dry etch dielectric

materials such as doped and undoped silicon dioxide. *See, e.g.,* col. 2, lines 32-43. Ding also teaches that, by use of the dry etchant disclosed therein, dielectric materials, such as doped and undoped silicon oxides, may be removed with selectivity over underlying substrate materials, such as silicon or gallium arsenide. *See, e.g.,* col. 3, lines 49-54. Ding further provides that the dry etchant chemical combination etches dielectric materials with selectivity over both photoresist materials and polysilicon. Col. 7, lines 44-49. Among the various fluorocarbons that are specifically disclosed in Ding as being useful in the chemical combination are CHF_3 and $C_2H_4F_2$. *See, e.g.,* col. 2, line 62, to col. 3, line 2.

Ding teaches that the ammonia-generating gas and the carbon-oxygen gas are essential parts of the dry etchants disclosed thereon. *See, e.g.,* col. 6, lines 14-50.

Bosch

Bosch teaches dry etchants that include CHF_3 (Freon-23) and neon (Ne) and that are useful for removing doped silicon oxide with selectivity over undoped silicon oxide, silicon nitride, silicides, and silicon. *See, e.g.,* col. 2, lines 34-44. Any of these materials may, therefore, be used as an etch stop when a doped silicon oxide is being dry etched with the disclosed combination of CHF_3 and Ne. *See, e.g.,* col. 4, lines 43-48. Bosch does not disclose, teach, or suggest any dry etchant that includes $C_2H_xF_y$, where x is an integer from three to five, inclusive, y is an integer from one to three, inclusive, and $x + y = 6$. Nor does Bosch disclose, teach, or suggest that any such dry etchant chemical combination may be used to dry etch doped silicon oxide with selectivity over undoped silicon oxide or even that doped silicon oxide may be dry etched with such a chemical combination.

Bosch also repeatedly emphasizes the importance of including neon in the dry etchant. *See, e.g.,* col. 2, lines 45-48; col. 5, lines 38-41; col. 6, lines 13-28. More specifically, Bosch teaches that neon imparts the dry etchant mixtures disclosed therein with selectivity. Col. 6, lines 13-28. In this regard, Bosch teaches that neon is an essential ingredient of the dry etchants disclosed therein. *See id.; see also* col. 5, lines 34 & 35.

(3) Independent Claim 20

Independent claim 20 recites a dry etchant which consists essentially of at least one fluorocarbon. The at least one fluorocarbon of amended independent claim 20 includes a component which comprises $C_2H_xF_y$, where x is an integer from three to five, inclusive, y is an integer from one to three, inclusive, and $x + y = 6$. In addition, amended independent claim 20 recites that the dry etchant thereof is formulated to etch doped silicon dioxide at a faster rate than at least undoped silicon dioxide.

(4) Analysis

It is respectfully submitted that Ding and Bosch do not support a *prima facie* case of obviousness against any of claims 1, 2, 4, 5, and 7-46 since Ding and Bosch both teach away from the subject matter recited in claims 1, 2, 4, 5, and 7-46.

In particular, Ding teaches a dry etchant combination which requires one or more fluorohydrocarbon gases, one or more NH_3-generating gases, and a carbon-oxygen gas. Col. 2, lines 37-43; col. 2, lines 52-61. Bosch teaches a dry etchant combination which, in addition to a

fluorocarbon, must also include neon. *See, e.g.,* col. 2, lines 45-48; col. 5, lines 34 & 35; col. 5, lines 38-41; col. 6, lines 13-28.

In fact, Ding expressly states that both the NH_3-generating gas and the carbon-oxygen gas materially change the characteristics of a dry etchant which lacks these component. Ding provides that the NH_3-generating "provides increased etch rates and higher etching selectivity." Col. 6, lines 16-19; *see, generally,* col. 6, line 14, to col. 8, line 64. Ding also explains that the inclusion of a carbon-oxygen gas in the fluorocarbon-containing dry etchant thereof "substantially improves the processing window of the etching process, allowing the process to be operated in a wider range of process conditions." Col. 9, lines 25-28; *see, generally,* col. 8, line 65, to col. 10, line 38.

Bosch also expressly provides that neon imparts the dry etchant disclosed therein with a "special advantage." Col. 2, lines 45-48; col. 6, lines 13-28. In particular, Bosch teaches that neon provides a "high degree of selectivity . . .," "a better profile for the sidewall of the etched opening . . .," and "a sharper edge to the top of the opening . . ." Col. 6, lines 17-22. Therefore, according to Bosch, a dry etchant that includes neon has materially different characteristics than a similar fluorocarbon-containing dry etchant that lacks neon.

In contrast, independent claim 20 recites a dry etchant which *consists essentially of* at least one fluorocarbon comprising a component with the general formula $C_2H_xF_y$, where x is an integer from three to five, inclusive, y is an integer from one to three, inclusive, and $x + y = 6$. While this language does not exclude the presence of components, such as a carrier gas, which are not essential to the characteristics of the recited dry etchant, it does exclude other

components, such as neon, an NH_3-generating gas, and a carbon-oxygen gas, that would materially alter the characteristics of the recited dry etchant. *See* M.P.E.P. § 2111.03.

As Ding and Bosch teach dry etchants which include fluorocarbons, as well as additional, nonfluorocarbon ingredients which are essential to the desired functions of such dry etchants, these references both teach away from the subject matter recited in amended independent claim 20, it is respectfully submitted that the subject matter recited in these claims is allowable over the combination of Ding and Bosch.

Due to the presence of additional ingredients in the dry etchants taught in Ding and Bosch, one of ordinary skill in the art could not reasonably expect the asserted combination of teachings from Ding and Bosch to successfully result in the claimed subject matter.

Moreover, as Ding and Bosch both teach dry etchant mixtures which include an essential component other than a fluorocarbon, it is respectfully submitted that neither Bosch nor Ding, taken separately or together, teaches or suggests a dry etchant that *consists essentially of* the elements recited in independent claim 20.

As independent claim 1 stands and falls with independent claim 20, it is also allowable over the teachings of Ding and Bosch.

Claims 2, 4, 5, 7-19, and 39-42 are each allowable, among other reasons, for depending either directly or indirectly from claim 1, which is allowable.

Claims 21-38 and 43-46 are each allowable, among other reasons, for depending either directly or indirectly from claim 20, which is allowable.

In view of the foregoing, it is respectfully submitted that a *prima facie* case of obviousness has not been established against any of claims 1, 2, 4, 5, or 7-46.

For these reasons, reversal of the 35 U.S.C. § 103(a) rejections of claims 1, 2, 4, 5, and 7-46 is respectfully requested.

(9) APPENDIX

A copy of claims 1, 2, 4, 5, and 7-46 is included herewith as the "Appendix."

(10) CONCLUSIONS

It is respectfully submitted that:

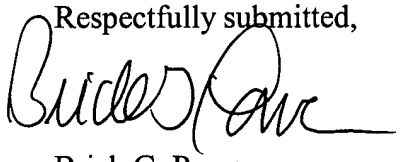
(A) Claims 1, 2, 4, 5, and 7-46 recite subject matter which is described in the specification of the '324 Application in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the '324 Application was filed, had possession of the claimed invention and, thus, which complies with the requirements of the first paragraph of 35 U.S.C. § 112;

(B) The recitation of "consisting essentially of" in claims 1, 2, 4, 5, and 7-46 complies with the definiteness requirement of 35 U.S.C. § 112, second paragraph; and

(C) Claims 1, 2, 4, 5, and 7-46 are directed to subject matter that, under 35 U.S.C. § 103(a), is patentable over the subject matter taught in Ding, in view of teachings from Bosch.

Therefore, it is respectfully requested that the rejections of claims 1, 2, 4, 5, and 7-46 be reversed and that each of these claims be allowed.

Respectfully submitted,



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APPENDIX

CLAIMS

1. A dry etchant, consisting essentially of:

a first component with the general formula $C_2H_xF_y$, where x is an integer from 3 to 5, inclusive, y is an integer from 1 to 3, inclusive, and $x + y = 6$; and

a second component consisting of at least one fluorocarbon,

the dry etchant being formulated to etch doped silicon dioxide with selectivity over at least undoped silicon dioxide.

2. The dry etchant of claim 1, also being formulated to etch doped silicon dioxide with selectivity over silicon nitride.

3. (Canceled)

4. The dry etchant of claim 1, wherein the first component is a primary etchant.

5. The dry etchant of claim 4, wherein the second component is an additive.

6. (Canceled)

7. The dry etchant of claim 1, wherein the second component consists of at least one fluorocarbon having at least as many hydrogen atoms as fluorine atoms.

8. The dry etchant of claim 7, wherein the at least one fluorocarbon comprises at least one of CH_2F_2 and CH_3F.

9. The dry etchant of claim 1, wherein the fluorocarbon comprises at least one of CF_4 and CHF_3.

10. The dry etchant of claim 5, wherein the additive increases a rate with which the dry etchant etches doped silicon dioxide over a rate at which the first component alone etches doped silicon dioxide.

11. The dry etchant of claim 10, wherein the additive comprises at least one of CF_4 and CHF_3.

12. The dry etchant of claim 5, wherein the additive increases a selectivity with which the first component etches doped silicon oxide over at least undoped silicon dioxide over the selectivity of the first component alone.

13. The dry etchant of claim 12, wherein the additive comprises at least one of CH_2F_2 and CH_3F.

14. The dry etchant of claim 5, wherein the additive increases a selectivity of the first component for one type of doped silicon dioxide over another type of doped silicon dioxide over the selectivity of the first component alone.

15. The dry etchant of claim 1, wherein the first component comprises an additive and the second component comprises a primary etchant.

16. The dry etchant of claim 15, wherein the primary etchant comprises at least one of CF_4 and CHF_3.

17. The dry etchant of claim 15, wherein a combination of the first component and the primary etchant etches doped silicon dioxide with greater selectivity over at least undoped silicon dioxide than a selectively of the primary etchant alone.

18. The dry etchant of claim 15, wherein a combination of the first component and the primary etchant etches doped silicon dioxide at substantially a same rate as an etchant that includes the primary etchant but not the first component etches doped silicon dioxide.

19. The dry etchant of claim 1, wherein relative concentrations of the first component and the second component are tailored to provide for at least one of a particular etch selectivity of doped silicon dioxide over undoped silicon dioxide, a particular etch selectivity of doped silicon dioxide over silicon nitride, and a particular etch rate of doped silicon dioxide.

20. A dry etchant consisting essentially of at least one fluorocarbon, the at least one fluorocarbon comprising a component with the general formula $C_2H_xF_y$, where x is an integer from 3 to 5, inclusive, y is an integer from 1 to 3, inclusive, and $x + y = 6$, the dry etchant being formulated to etch doped silicon dioxide at a faster rate than at least undoped silicon dioxide.

21. The dry etchant of claim 20, also being formulated to etch doped silicon dioxide at a faster rate than silicon nitride.

22. The dry etchant of claim 20, including a combination of components.

23. The dry etchant of claim 22, wherein the component is a primary etchant.

24. The dry etchant of claim 23, further comprising an additive.

25. The dry etchant of claim 24, wherein the additive comprises a halogenated carbon dry etchant material.

26. The dry etchant of claim 24, wherein the additive comprises a fluorocarbon having at least as many hydrogen atoms as fluorine atoms.

27. The dry etchant of claim 26, wherein the fluorocarbon comprises at least one of CH_2F_2 and CH_3F.

28. The dry etchant of claim 24, wherein the additive comprises at least one of CF_4 and CHF_3.

29. The dry etchant of claim 23, wherein the additive increases a rate with which the dry etchant etches doped silicon dioxide over a rate at which the component alone etches doped silicon dioxide.

30. The dry etchant of claim 29, wherein the additive comprises at least one of CF_4 and CHF_3.

31. The dry etchant of claim 23, wherein the additive increases a selectivity with which the dry etchant etches doped silicon oxide over at least undoped silicon dioxide over the selectivity of the component alone.

32. The dry etchant of claim 31, wherein the additive comprises at least one of CH_2F_2 and CH_3F.

33. The dry etchant of claim 23, wherein the additive increases a selectivity of the dry etchant for one type of doped silicon dioxide over another type of silicon dioxide over the selectivity of the component alone.

34. The dry etchant of claim 22, wherein the component comprises an additive for use with another, primary etchant.

35. The dry etchant of claim 34, wherein the primary etchant comprises at least one of CF_4 and CHF_3.

36. The dry etchant of claim 34, wherein the combination of the component and the primary etchant etches doped silicon dioxide with greater selectivity over at least undoped silicon dioxide than a selectively of the primary etchant alone.

37. The dry etchant of claim 34, wherein the combination of the component and the primary etchant etches doped silicon dioxide at a substantially normal rate.

38. The dry etchant of claim 22, wherein relative concentrations of the component and the primary etchant in the combination are tailored to provide for at least one of a particular etch selectivity of doped silicon dioxide over undoped silicon dioxide, a particular etch selectivity of doped silicon dioxide over silicon nitride, and a particular etch rate of doped silicon dioxide.

39. The dry etchant of claim 1, wherein the first component comprises up to about 65% of a total gas flow of the dry etchant.

40. The dry etchant of claim 1, wherein the first component comprises up to about 40% of a total gas flow of the dry etchant.

41. The dry etchant of claim 40, wherein the second component comprises up to about 60% of the total gas flow.

42. The dry etchant of claim 1, further including at least one carrier gas.

43. The dry etchant of claim 20, wherein the component comprises up to about 65% of a total gas flow of the dry etchant.

44. The dry etchant of claim 20, wherein the component comprises up to about 40% of a total gas flow of the dry etchant.

45. The dry etchant of claim 43, wherein at least one other component comprises up to about 60% of the total gas flow.

46. The dry etchant of claim 20, further including at least one carrier gas.